

(3) The epochs of maximum and minimum temperatures are retarded as the altitude increases

(4) The differences of temperature from day to day can be larger at 7,000 or 8,000 meters altitude than those experienced at the same time near the ground.

(5) Temperature decreases far more rapidly in the neighborhood of a center of depression than elsewhere; this decrease can in certain cases amount to  $0.9^{\circ}$  C. per 100 meters.

(6) In a large number of areas of high pressure, but not in all, the diminution of temperature goes on as follows: From the ground up to 1,500 meters or 2,000 meters the temperature changes but little and often rises, after which it commences to diminish normally, and finally at 9,000 or 10,000 meters the gradient is about  $1^{\circ}$  per 100 meters. If we compare these facts with those that occur in areas of low pressure, we see that a vertical gradient has the following characteristics: The lower parts of barometric depressions, are often warmer than those of the areas of high pressure; after ascending a few hundred meters, within the area of low pressure, the rapid diminution brings us to temperatures that are lower than in the area of high pressure. Thus, the central part of a depression as at 3,000 or 4,000 meters altitude is ordinarily colder than the corresponding part of an area of maximum pressure. This fact had already been shown by Hann, but the sounding balloons, while confirming this first result, show that still higher up the temperatures again tend toward equality, which

is a very important consideration in determining the forms of the upper isobars.

Similar conclusions based on more accurate observations, are also given in the great work of Assmann and Berson *Wissenschaftliche Luftfahrten*, 3 volumes, Braunschweig, 1900.

#### ERRATA.

In the MONTHLY WEATHER REVIEW for March, 1901, p. 122, please strike out under the heading "errata" the last item: "line 25 from bottom, for  $530^{\circ}$  read  $562^{\circ}$ ." The original text was correct.

Prof. F. Pockels has sent us the following corrections to his article on "The theory of the formation of precipitation on mountain slopes" in the current number of the REVIEW; but, unfortunately, they were received too late to be incorporated in the text:

Page 156, column 2, line 8 from the bottom, for " $x = -6.3$ ," read " $x = -1.3$ ."

Page 157, column 2, right-hand side of the second equation

from bottom, for  $\frac{1}{q} \left( \frac{q^q}{c^2} - \frac{q^n}{2} \right)$   
read  $\frac{1}{q} \left( \frac{q^q}{c^2} - \frac{q^n}{2} \right)$ .

### THE WEATHER OF THE MONTH.

By ALFRED J. HENRY, Professor of Meteorology

#### CHARACTERISTICS OF THE WEATHER FOR APRIL.

April, 1901, was characterized by unusually high pressure in the Lake region and over New England, a heavy rainfall along the Appalachians and eastward to the Atlantic, high temperatures over the northern third of the country, and cold weather in the South Atlantic and Gulf States. Precipitation was also in excess of the normal in the Rocky Mountain region and over the major portion of the southern Plateau, as was the case in the corresponding month of 1900.

Heavy snow, mixed with rain, fell along the Appalachians and in the upper Ohio Valley on the 20th and 21st, causing floods in the Allegheny and upper Ohio rivers during the latter part of the month.

Another striking characteristic of the month was the absence of thunderstorms and violent local storms. The number of thunderstorms that occurred in April, 1900, was 2,617; less than a tenth of that number was reported during the current month.

Interlake navigation began about April 8, but owing to a heavy ice gorge which formed at the foot of Lake Huron, passage into or out of that lake at its southern end was effectively blocked until the 26th of the month.

#### PRESSURE.

The distribution of monthly mean pressure is graphically shown on Chart IV and the numerical values are given in Tables I and VI.

The most striking feature in the distribution of mean pressure is the apparent shifting eastward of the area of high pressure which in a normal month is found over the Dakotas and the Northwest and the absence of the ridge of high pressure that usually extends from the south Atlantic coast northwestward to the Dakotas. Owing to the persistence of areas of low pressure along the Atlantic coast, monthly mean pressure was least off Chesapeake Bay, with mean values of 29.94 inches. As compared with the preceding month, pressure rose about a quarter of an inch in the upper Lake region and as much as three-tenths of an inch over the mouth of the St. Lawrence. There was a fall in monthly mean pressure over the Plateau region and also over the South Atlantic States, the greatest fall being a little more than a tenth of an inch. It was also below normal along the middle and south Atlantic coasts and in the Plateau region. Pressure was largely in excess of the normal over New England, the Canadian Maritime Provinces, the Lake region, and also along the Pacific coast.

#### TEMPERATURE OF THE AIR.

The distribution of monthly mean surface temperature, as deduced from the records of about 1,000 stations, is shown on Chart VI.

The month was cold and backward in the South Atlantic States, the Ohio Valley, the lower Mississippi Valley, and the Southwest. The greatest negative departures, viz,  $6^{\circ}$  to  $8^{\circ}$  daily, were recorded in South Carolina, northern Georgia, and western North Carolina. The month was warmer than usual in New England and thence westward to the upper Missouri Valley, positive departures of  $7^{\circ}$  being registered in portions of that region. Temperature was below normal west of the Rocky Mountains and over the middle and southern slopes. Maximum temperatures of  $100^{\circ}$  were recorded in the lower Rio Grande Valley and in Arizona and the desert

regions of California. A maximum temperature as high as 80° was not registered along the Atlantic coast north of Florida nor in New England and the lower Lake region.

Minimum temperatures of 32° or less were registered from eastern Tennessee and northern Georgia, northeastward to the White Mountains and northern and central Maine. In the lower Lake region minimum temperatures as low as 20° were registered at some distance from the lakes. Along the lakes, however, no minimum temperature lower than 30° was observed. In the Rocky Mountain region temperatures as low as zero were observed along the higher elevations.

The average temperature for the several geographic districts and the departures from the normal values are shown in the following table:

*Average temperatures and departures from the normal.*

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
New England.....	10	43.5	+ 0.6	- 3.3	- 0.8
Middle Atlantic.....	12	49.3	- 1.4	- 4.0	- 1.0
South Atlantic.....	10	56.2	- 5.8	-11.0	- 2.8
Florida Peninsula.....	7	66.5	- 4.3	-12.1	- 3.0
East Gulf.....	7	61.5	- 4.8	-10.0	- 2.5
West Gulf.....	7	63.8	- 3.3	+ 0.5	+ 0.1
Ohio Valley and Tennessee.....	12	51.2	- 4.7	- 8.7	- 2.2
Lower Lake.....	8	45.5	+ 0.8	- 4.8	- 1.2
Upper Lake.....	9	43.5	+ 3.3	+ 2.4	+ 0.6
North Dakota.....	8	45.1	+ 8.5	+15.8	+ 4.0
Upper Mississippi Valley.....	11	51.4	+ 0.3	+ 1.9	+ 0.5
Missouri Valley.....	10	51.6	+ 0.7	+10.5	+ 2.6
Northern Slope.....	7	44.9	+ 0.3	+ 8.7	+ 2.2
Middle Slope.....	6	52.0	- 2.2	+ 0.1	+ 0.2
Southern Slope.....	6	55.5	- 2.6	+ 1.1	+ 0.3
Southern Plateau.....	15	52.2	- 2.5	+ 5.6	+ 1.4
Middle Plateau.....	9	46.5	- 1.1	+ 8.3	+ 2.1
Northern Plateau.....	10	45.0	- 1.2	+ 6.6	+ 1.6
North Pacific.....	9	46.2	- 2.5	+ 9.1	+ 2.3
Middle Pacific.....	5	52.5	- 1.9	+ 1.3	+ 0.3
South Pacific.....	4	57.0	- 1.6	+ 5.4	+ 1.4

*In Canada.*—Prof. R. F. Stupart says:

The mean temperature of April was higher than the average over the Dominion from Manitoba eastward, the positive departure ranging between 3° and 6° in nearly all districts, southwestern Ontario and western Manitoba alone showing somewhat smaller departures. In the Northwest Territories the mean temperature was very nearly normal, and in British Columbia there was a minus departure of from 1° to 3°.

#### PRECIPITATION.

The month as a whole was unusually rainy, except in the Mississippi Valley, the lower Ohio and the lower Missouri valleys. More than the normal amount of rain fell in the Rocky Mountain region and westward to the Pacific. The rainfall in western Nebraska, Kansas, western Oklahoma and northern Texas was also considerably in excess of the normal values, while along and east of the Appalachians, excepting only a narrow fringe along the coast of the Carolinas and Georgia, the rainfall was from 2 to 3 inches in excess of the normal. On the southern New England coast rainfall was about 5 inches in excess of the average amount.

Heavy snow fell in the lower Lake region, western Pennsylvania, eastern Ohio, West Virginia, and throughout the Appalachian region, in western North Carolina, and eastern Tennessee. There was also a greater amount of snow than usual in eastern Kansas and throughout the central Rocky Mountain region.

The distribution of snowfall is shown by Chart IX.

#### SLEET.

The following are the dates on which sleet fell in the respective States:

Alabama, 1, 19. Arizona, 4, 17. Arkansas, 1, 8. Califor-

nia, 2, 3, 9, 13, 14, 25, 28, 29, 30. Colorado, 2, 16. Connecticut, 3. Georgia, 1, 20, 21. Illinois, 1, 2, 18, 21, 22. Indiana, 2, 18, 21. Iowa, 2, 5, 16. Louisiana, 17. Maine, 3, 10. Michigan, 2, 17, 18, 21. Minnesota, 3, 5, 16. Missouri, 1, 16, 17, 18, 27. Nebraska, 1, 15, 16, 17, 18, 19. Nevada, 2. New Hampshire, 3. New Jersey, 3. New Mexico, 4. New York, 3, 7, 8, 9, 15, 19, 20. North Carolina, 1, 2, 20. North Dakota, 4, 11. Ohio, 2, 3, 18, 19, 20, 21, 24. Oklahoma, 16, 17. Oregon, 2, 3, 5, 6, 7, 30. Pennsylvania, 2, 20. Rhode Island, 13. South Dakota, 1, 2, 4, 15, 18. Tennessee, 1, 2, 3, 18, 19, 20, 21. Utah, 3, 6, 7, 10, 15, 16, 17. Vermont, 3. Virginia, 1, 2, 13, 20. Washington, 1, 2, 3, 5, 6, 23. Wisconsin, 5. Wyoming, 7, 13, 23.

#### HAIL.

The following are the dates on which hail fell in the respective States:

Alabama, 1, 28. Arizona, 1, 6, 10, 16, 17. Arkansas, 1, 8, 10, 12, 13, 17. California, 2, 3, 6, 29, 30. Colorado, 1, 3, 4, 8, 9, 12, 23. Connecticut, 23. Delaware, 2, 3. Florida, 30. Georgia, 1, 13, 20. Idaho, 1, 2, 3, 4, 6, 7, 14. Illinois, 17. Indiana, 1, 2, 17, 18, 28. Iowa, 2, 16, 17, 27, 28. Kansas, 5, 8, 10, 11, 12, 26. Kentucky, 2, 18. Louisiana, 10, 17, 18, 25. Maryland, 14, 20. Massachusetts, 26. Michigan, 2, 21. Minnesota, 27. Missouri, 5, 12, 13, 17, 25, 27, 28. Montana, 2. Nebraska, 1, 16, 23, 26. Nevada, 2, 3, 6, 7, 8, 14, 30. New Mexico, 10, 24, 28, 30. New York, 3, 5, 8, 9, 19, 20, 22, 26. North Carolina, 23. North Dakota, 26, 27. Oklahoma, 10, 11, 15, 17, 26, 27. Oregon, 1, 2, 3, 4, 5, 6, 7, 14, 20, 24, 25, 26, 27, 28, 29, 30. Pennsylvania, 3, 20. South Dakota, 18, 23, 26, 27, 29. Texas, 9, 17, 26, 28. Utah, 2, 3, 4, 9, 14, 15, 16. Washington, 1, 2, 3, 4, 5, 6, 11, 13, 14, 20, 21, 22, 23, 25, 28, 29. Wisconsin, 21.

*Average precipitation and departure from the normal.*

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
New England.....	10	<i>Inches.</i> 6.20	197	<i>Inches.</i> +3.0	+0.5
Middle Atlantic.....	12	5.08	155	+1.8	-2.1
South Atlantic.....	10	3.61	108	+0.1	-1.7
Florida Peninsula.....	7	1.61	17	-0.8	+0.8
East Gulf.....	7	5.80	132	+1.4	+0.5
West Gulf.....	7	2.94	77	-0.9	-5.5
Ohio Valley and Tennessee.....	12	4.21	105	+0.2	-5.4
Lower Lake.....	8	2.96	125	+0.6	-2.8
Upper Lake.....	9	0.93	40	-1.4	-0.3
North Dakota.....	8	1.15	59	-0.8	-1.4
Upper Mississippi Valley.....	11	1.65	56	-1.3	-2.2
Missouri Valley.....	10	2.07	67	-1.0	-1.5
Northern Slope.....	7	2.04	124	+0.4	0.0
Middle Slope.....	6	2.99	143	+0.9	-0.5
Southern Slope.....	6	2.61	118	+0.4	+1.4
Southern Plateau.....	15	0.37	79	-0.1	+0.9
Middle Plateau.....	9	0.98	91	-0.1	0.0
Northern Plateau.....	10	1.08	78	-0.3	-1.0
North Pacific.....	9	5.77	129	+1.3	+0.6
Middle Pacific.....	5	2.64	108	+0.2	+0.4
South Pacific.....	4	1.62	72	-0.4	+1.5

*In Canada.*—Professor Stupart says:

Except in the western portions of the Northwest Territories and in Prince Edward Island, the precipitation was very generally in excess of the average; however, there were no very pronounced positive departures, except locally in the Maritime Provinces and between Regina and Brandon in the northwest, in which latter district there was an unusually heavy snowfall between the 14th and 15th, when 18 inches fell at Qu'Appelle. In Ontario the heaviest precipitation occurred near Lake Ontario, and the most abnormal feature was a snowfall of between 4 and 6 inches, which occurred on the 20th, in connection with a storm movement northward across the Middle States.

#### HUMIDITY.

The averages by districts appear in the subjoined table:

*Average relative humidity and departures from the normal.*

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England .....	81	+ 9	Missouri Valley .....	86	+ 1
Middle Atlantic .....	83	+ 1	Northern Slope .....	83	+ 5
South Atlantic .....	86	+ 6	Middle Slope .....	84	+ 9
Florida Peninsula .....	88	+ 7	Southern Slope .....	55	+ 2
East Gulf .....	64	+ 8	Southern Plateau .....	33	+ 3
West Gulf .....	69	+ 3	Middle Plateau .....	47	+ 0
Ohio Valley and Tennessee .....	72	+ 2	Northern Plateau .....	60	+ 3
Lower Lake .....	71	+ 2	North Pacific Coast .....	74	+ 5
Upper Lake .....	73	+ 3	Middle Pacific Coast .....	63	+ 9
North Dakota .....	73	+ 5	South Pacific Coast .....	67	+ 2
Upper Mississippi .....	65	0			

**SUNSHINE AND CLOUDINESS.**

The distribution of sunshine is graphically shown on Chart VII, and the numerical values of average daylight cloudiness, both for individual stations and by geographical districts, appear in Table I.

The averages for the various districts, with departures from the normal, are shown in the table below:

*Average cloudiness and departures from the normal.*

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England .....	7.4	+2.1	Missouri Valley .....	5.1	-0.3
Middle Atlantic .....	6.6	+1.4	Northern Slope .....	5.5	-0.2
South Atlantic .....	4.7	+0.3	Middle Slope .....	5.5	+0.8
Florida Peninsula .....	3.3	-0.6	Southern Slope .....	4.4	0.0
East Gulf .....	4.5	0.0	Southern Plateau .....	3.2	+0.4
West Gulf .....	4.6	-0.6	Middle Plateau .....	4.3	+0.3
Ohio Valley and Tennessee .....	6.0	+0.7	Northern Plateau .....	5.4	-0.9
Lower Lake .....	6.0	+0.5	North Pacific Coast .....	6.1	-0.4
Upper Lake .....	5.2	-0.5	Middle Pacific Coast .....	3.7	-0.9
North Dakota .....	5.6	+0.1	South Pacific Coast .....	3.3	-0.6
Upper Mississippi .....	5.1	-0.4			

**WIND.**

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

*Maximum wind velocities.*

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Abilene, Tex. ....	4	50	w.	Memphis, Tenn. ....	5	52	sw.
Do. ....	5	50	w.	Moorhead, Minn. ....	5	52	se.
Amarillo, Tex. ....	4	80	nw.	Mount Tamalpais, Cal. ....	10	61	nw.
Do. ....	5	58	nw.	Do. ....	13	55	nw.
Atlanta, Ga. ....	19	56	nw.	Do. ....	16	50	nw.
Do. ....	20	54	nw.	Do. ....	20	56	nw.
Block Island, R. I. ....	3	51	e.	Do. ....	21	60	nw.
Do. ....	15	56	ne.	Do. ....	24	50	nw.
Do. ....	16	63	ne.	Do. ....	25	75	nw.
Do. ....	26	54	ne.	Do. ....	26	56	nw.
Charleston, S. C. ....	19	50	se.	Do. ....	28	50	s.
Chattanooga, Tenn. ....	18	55	s.	Do. ....	15	54	ne.
Chicago, Ill. ....	21	56	ne.	Nantucket, Mass. ....	16	50	ne.
Cleveland, Ohio .....	20	60	n.	Do. ....	1	52	nw.
Detroit, Mich. ....	20	52	ne.	New York, N. Y. ....	7	50	nw.
Eastport, Me. ....	4	54	e.	Do. ....	21	50	se.
Do. ....	7	51	e.	Do. ....	6	60	nw.
El Paso, Tex. ....	1	56	sw.	Point Reyes Light, Cal. ....	3	50	ne.
Do. ....	4	74	w.	Portland, Me. ....	7	50	ne.
Fort Smith, Ark. ....	5	52	sw.	Do. ....	5	52	nw.
Huron, S. Dak. ....	3	63	se.	Wichita, Kans. ....	2	59	sw.
Do. ....	26	56	se.	Winnemucca, Nev. ....	26	50	s.
Lincoln, Nebr. ....	5	60	n.	Yankton, S. Dak. ....			

**ATMOSPHERIC ELECTRICITY.**

Numerical statistics relative to auroras and thunderstorms are given in Table IV, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

*Thunderstorms.*—Reports of 1,202 thunderstorms were received during the current month as against 2,617 in 1900 and 1,597 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country were most numerous were: 28th, 100; 16th, 86; 12th, 81.

Reports were most numerous from: Missouri, 126; Kansas, 102; Colorado, 93.

*Auroras.*—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz: March 30 to April 7.

*In Canada.*—Auroras were reported as follows: Father Point, 13th; Port Arthur, 24th; Medicine Hat, 23d; Victoria, 12th.

Thunderstorms were reported as follows: Winnipeg, 25th, 26th; Battleford, 30th; Victoria, 20th; Hamilton, Bermuda, 7th, 22d, 23d.

**DESCRIPTION OF TABLES AND CHARTS.**

By ALFRED J. HENRY, Professor of Meteorology.

Table I gives, for about 145 Weather Bureau stations making two observations daily and for about 25 others making only one observation, the data ordinarily needed for climatological studies, viz, the monthly mean pressure, the monthly means and extremes of temperature, the average conditions as to moisture, cloudiness, movement of the wind, and the departures from normals in the case of pressure, temperature, and precipitation, the total depth of snowfall, and the mean wet-bulb temperatures. The altitudes of the instruments above ground are also given.

Table II gives, for about 2,700 stations occupied by voluntary observers, the highest maximum and the lowest minimum temperatures, the mean temperature deduced from the average of all the daily maxima and minima, or other readings, as in-

dicated by the numeral following the name of the station; the total monthly precipitation, and the total depth in inches of any snow that may have fallen. When the spaces in the snow column are left blank it indicates that no snow has fallen, but when it is possible that there may have been snow of which no record has been made, that fact is indicated by leaders, thus (. . .).

Table III gives, for all stations that make observations at 8 a. m. and 8 p. m., the four component directions and the resultant directions based on these two observations only and without considering the velocity of the wind. The total movement for the whole month, as read from the dial of the Robinson anemometer, is given for each station in Table I. By adding the four components for the stations comprised in